~~PROGRESS~~ REPORT

URBAN CONTAMINANTS PROJECT: DATA FOR SEDIMENT, FISH AND EGGS COLLECTED FROM CHESTER CREEK, ANCHORAGE, ALASKA 1991.

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April 6, 1994

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INTRODUCTION

Urbanization has degraded the water quality and adversely impacted biological communities in the lakes and streams of Anchorage (Hock, 1981; Brabets, 1987; Milner and Oswood, 1989, 1990). The waterways of Fish, Ship, Chester, Campbell and Rabbit Creeks are threatened by development and pollution. Altered hydrological cycles and decreased habitat diversity have resulted from the destruction of area wetlands (Tande, 1988). Pollution from point and non-point sources have contaminated the streams with fecal coliform bacteria, metals, organics and petroleum products (Hock, 1981; Brabets, 1987).

The U.S. Fish and Wildlife Service (Service) suspects that this documented decrease in Anchorage's water quality is detrimental to the area's trust resources (i.e migratory birds and anadromous fish). Therefore, in 1991, an Urban Contaminants Project was initiated to monitor wildlife use, water quality and sediment contamination in the five major creeks of the Anchorage basin. The study is designed to sample one stream a year with follow-up monitoring to occur once every five years. The potential chronic effects of poor water quality and stream degradation to fish and wildlife are evaluated using field observations, chemical analysis of sediment and tissues, and bioassays using water and sediment.

The first year's effort was designed to scope the study's approach, integrity and methods. Due to local pollution concerns, and because additional limnological and biological information exists, the first survey was conducted on Chester Creek. The Service entered into a cooperative agreement with the Environment and Natural Resources Institute (ENRI), University of Alaska, Anchorage, to develop and validate invertebrate bioassays. Their findings are reported elsewhere (Gabrielson and Milner, 1992). This report presents the results of chemical residue analysis of sediments, fish and migratory bird eggs collected from the Chester Creek drainage in 1991.

SITE DESCRIPTION

Chester Creek originates in the Chugach Mountains and runs through a highly urbanized watershed before draining into the Knik Arm of Cook Inlet. The creek has three major forks: The South Fork forms the headwaters, which drain an

undeveloped watershed in the Chugach foothills before reaching the Anchorage bowl. Within Anchorage, all forks of Chester Creek are impacted by development. The South Fork has been channelized and straightened, and sections of the Middle Fork have been routed through storm sewers (Brabets, 1987). Additionally, the North Fork of Chester Creek has been diverted into a corrugated metal conduit which bisects the Merrill Field Landfill. This conduit leaves the landfill and flows in an open ditch to its confluence with Chester Creek (Brunett, 1990). The 78 km^2 basin also contains three impoundments: University lake, which the south branch of the South Fork flows through; Hillstrand Pond, which is located downstream of the Middle Fork/South Fork confluence and Eastchester/Westchester lagoon, at the mouth of the creek (Brabets, 1987).

The Chester Creek drainage and sampling stations are illustrated in Figure 1, and the North Fork tributary sampling sites are shown in Figure 2. Not all of the Roman numerals listed on the maps as sampling sites were used in this study. The sampling stations were chosen based on previous invertebrate work conducted by Milner and Oswood (1989, 1990). Milner was the research cooperator in charge of the Chester Creek bioassays, and in the final bioassay report by Gabrielson and Milner (1992), sampling sites from earlier studies were included in their maps. Because the bioassay and the analytical results are being presented as separate documents, consistency in sampling site enumeration was needed. Therefore, all Roman numeral used as site identification remain on the map, even if several of the sites were not sampled. Additionally, the sites which were not used for this study are circled. Actual sampling sites, identification number and sampling dates are listed in Table 1.

MATERIALS AND METHODS

Sampling Procedures

Sediments

Sediment samples were collected from 10 in-stream sites and 8 impoundment sites along Chester Creek, between July 9, 1991 and September 13, 1991. Using an Ekman dredge, several grab samples were collected at each site and pooled in a stainless steel bowl. The sediment was mixed thoroughly using a stainless steel spoon, and from this composite, three samples were removed. Each one was placed into a 1-l acid washed glass jar, and the samples were refrigerated at

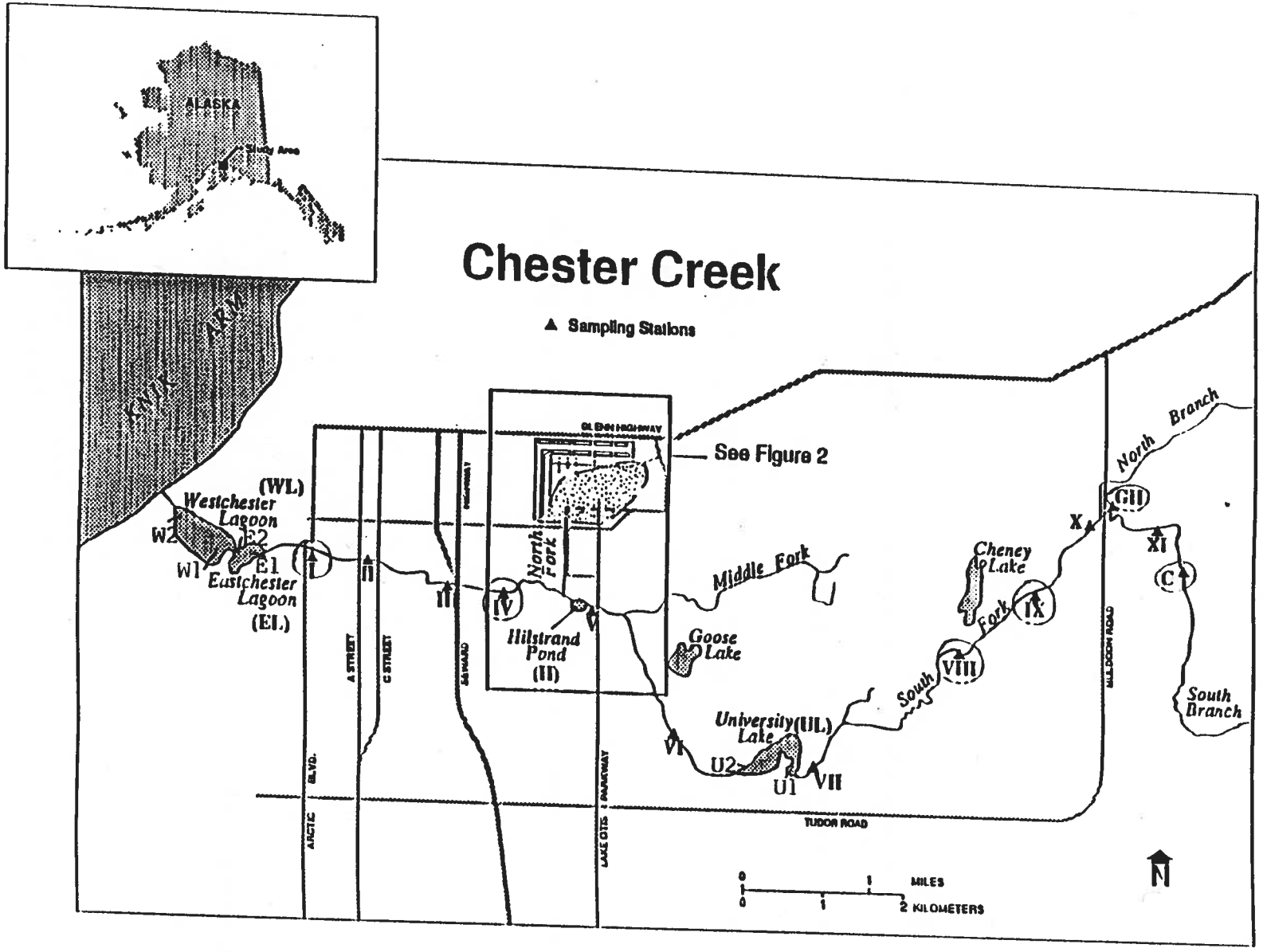

Figure 1. Sampling Sites for Chester Creek, Anchorage, AK. From Gabrielson and Milner (1992).

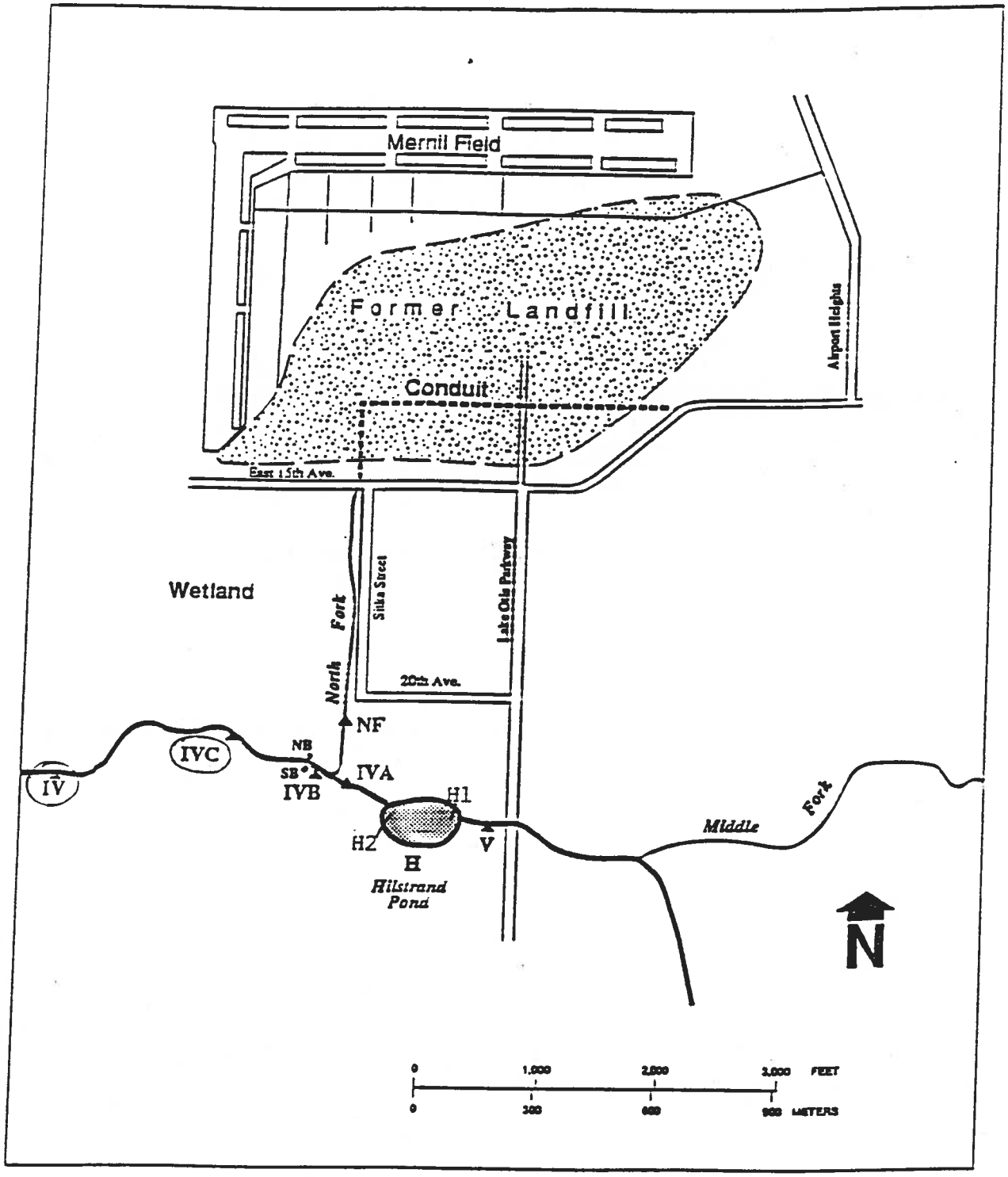

Figure 2. Sampling Sites near the North Fork Tributary of Chester Creek. From Gabrielson and Milner (1992).

Table 1. Sampling Sites for Sediment (Latitude: 61° N 12′ 00").

Sample Site	Date Collected	Longitude
XI	30 Aug 91	149° W 43′00"
X	30 Aug 91	149° W 44′00"
VII	04 Sep 91	149° W 47"25"
VI	04 Sep 91	149° W 48′45"
V	29 Aug 91	149° W 50′08"
IVa	09 Jul 91	149° W 50′32"
NF	01 Oct 91	149° W 50′37"
IVb	09 Jul 91	149° W 50′40"
III	29 Aug 91	149° W 51′59"
II	29 Aug 91	149° W 52′58"
U1	13 Sep 91	149° W 47′42"
U2	13 Sep 91	149° W 48′08"
H1	13 Sep 91	149° W 50′08"
H2	13 Sep 91	149° W 50′23"
E1	12 Jul 91	149° W 54′22"
E2	12 Jul 91	149° W 54′22"
W1	12 Jul 91	149° W 54′48"
W2	12 Jul 91	149° W 54′48"

4° C. The dredge, bowl and spoons were cleaned in the field between sites. Each implement was washed with tap water and given a final rinse with acetone.

Fish

Fish were collected from University lake and Eastchester lagoon using gill nets. Rainbow trout (*Salmo gairdneri*) were caught in both impoundments, but dolly varden (*Salvelinus malma*) were only collected from University lake. Fish were weighed to the nearest 0.1 g and total length was recorded. Whole fish were placed in plastic bags and frozen for chemical analyses.

Avian Eggs

Eggs from four avian species were collected from three impoundments on Chester Creek. Canada geese (*Branta canadensis*) and red-necked grebe (*Podiceps grisegena*) eggs were obtained from University lake. Mallard (*Anas platyrhynchos*) eggs were found on Eastchester lagoon, and mew gull (*Larus canus*) and red-necked grebe eggs were collected from Westchester lagoon. Eggs were weighed and morphometric data were recorded. Eggs were then scored around the midline, opened and contents were placed into chemically clean glass jars and frozen. Eggshells were air-dried for 2 months, and thickness measurements were made using a dial micrometer with rounded contacts. Five measurements were taken along the equator of each shell half and thickness was reported as the average of all ten measurements. The thickness index was also calculated for each egg (Ratcliffe, 1967).

Analytical Procedures

Analyses for metals and other inorganic substances were conducted at the University of Missouri's Environmental Trace Substances Research Center (Columbia, MO 65203) (Tables 2 and 3). All inorganic concentrations are expressed in parts per million (ppm) on a dry weight basis.

Texas A&M's Geochemical and Environmental Research Group (College Station, TX 77845) analyzed samples for polycyclic aromatic hydrocarbons (PAHs), organochlorine (OC) pesticides and polychlorinated biphenyls (PCBs) (Table 4). All PAHs and OC concentrations are expressed in ppm on a wet weight basis. The lower levels of detection for PAHs is 0.01 ppm; for PCBs is 0.5 ppm and for all other OCs is 0.02 ppm. Organic analyses were performed by capillary gas

Table 2. Analytical Methods and Detection Limits for Trace Elements in Sediment

Analyte	Method	Detection Limit (ppm Dry Weight)[d]
Al	ICP[a]	3.0
As	AA[b]	0.09-0.20
B	ICP	2.0
Ba	ICP	0.10
Be	ICP	0.10
Cd	ICP	0.20-0.30
Cr	ICP	0.90-1.0
Cu	ICP	0.20-0.40
Fe	ICP	0.80-6.0
Hg	CVAA[c]	0.01-0.03
Mg	ICP	0.20-3.0
Mn	ICP	0.20
Mo	ICP	1.0
Ni	ICP	1.0-2.0
Pb	ICP	4.0-5.0
Se	AA	0.20
Sr	ICP	0.10
V	ICP	0.30-0.70
Zn	ICP	0.20-0.30

[a]ICP = Inductively Coupled Plasma Spectrometry

[b]AA = Atomic Absorption Spectrophotometry

[c]CVAA = Cold Vapor Atomic Absorption

[d]Detection limits varied for each sample, therefore, the range of detection limits is reported for each element.

Table 3. Analytical Methods and Detections Limits for Trace Elements in Fish and Eggs.

Analyte	Method	Detection Limit (ppm Wet Weight)[d]
Al	ICP[a]	3.0
As	AA[b]	0.10
B	ICP	2.0
Ba	ICP	0.10
Be	ICP	0.01
Cd	ICP	0.2
Cr	ICP	0.10
Cu	ICP	0.40
Fe	ICP	1.0
Hg	CVAA[c]	0.005
Mg	ICP	0.20
Mn	ICP	0.20
Mo	ICP	1.0
Ni	ICP	0.10
Pb	ICP	0.40
Se	AA	0.20
Sr	ICP	0.10
V	ICP	0.30
Zn	ICP	0.30

[a]ICP = Inductively Coupled Plasma Spectrometry

[b]AA = Atomic Absorption Spectrophotometry

[c]CVAA = Cold Vapor Atomic Absorption

[d]Detection limits were identical for both fish and eggs.

Table 4. Polynuclear Aromatic Hydrocarbon (PAH) and Organochlorine (OC) Analytes.

PAHs	OCs
naphthalene = Np*	Total BHC's
1-methylnaphthalene = 1MeNp	Total Chlordanes
2-methylnaphthalene = 2MeNp	Total DDTs
2,6-dimethylnaphthalene = DiMe	Total PCBs
2,3,4-trimethylnaphthalene = TMeNp	Toxaphene
1-methylphenanthrene = 1MePh	
acenaphthalene = Acenpy	alpha-BHC
acenaphthene = Acenp	HCB
fluorene = Fluo	beta-BHC
phenanthrene = Phen	gamma-BHC
anthracene = Anth	delta-BHC
fluoranthene = FlAn	Heptachlor
pyrene = Pyr	Heptaepoxide
benzo(a)anthracene BaA	oxychlordane
chrysene = Chry	gamma-chlordane
benzo(b)fluoranthene =BbFl	alpha-chlordane
benzo(e)pyrene = BeP	trans-nonachlor
benzo(a)pyrene = BaP	cis-nonachlor
perylene = Pery	aldrin
indeno(1,2,3-c,d)pyrene = InPy	dieldrin
dibenzo(a,h)anthracene = DiBen	endrin
benzo(g,h,i)perylene = BghiPe	mirex
biphenyl = BiPh	2,4 and 4,4 DDE
	2,4 and 4,4 DDD
	2,4 and 4,4 DDT

*These abbreviations are used in all subsequent tables which present PAH data.

chromatography (CGS) with electron capture detector for OC pesticides and PCBs, and a mass spectrometer detector for PAHs.

Untabulated data and quality assurance/quality control reports are available upon request. Additionally, procedures concerning tissue and sediment preparation prior to chemical analysis can be provided (Environmental Trace Substance Research Center; Geochemical and Environmental Research Group).

RESULTS

Due to the small sample size, lack of replicates and absence of a rigorous study design, the data could not be analyzed statistically. Therefore, it is presented here in tabular form and summarized qualitatively.

Sediments

Inorganics

Data for metals and other elements detected in sediments are presented in Table 5 for in-stream sites and Table 6 for the impoundments.

Instream Sites

Cadmium, molybdenum and lead were not detected (above 2 times the detection limits) in sediment samples from the control site (XI), but all other analytes were present. Several analyte concentrations spiked at the first site (Site X) downstream of the control site and then returned to non-detectable concentrations or were substantially lower at the next two sites (VII and VI). At Site X, cadmium increased to 0.4 ppm and returned to below detection limits at sites VII and VI. Also, at Site X, lead increased to 110 ppm which was the highest concentrations detected in the stream. Although lead concentrations decreased to 29 ppm and 34 ppm at Sites VII and VI, respectively, lead increased to 73 ppm at Site V and remained above 50 ppm throughout the rest of the stream.

Sites V and IVa appear to have the greatest increase in concentration of inorganic analytes. Arsenic, barium, cadmium, copper, iron, mercury, manganese, nickel, lead and zinc all increase at least 100% over concentrations of these

Table 5. Sediment Analysis for Trace Elements: Instream sites. Values are expressed as ppm (Dry Weight).

ANALYTE	SITE									
	XI	X	VII	VI	V	IVa	NF	IVb	III	II
Al	16,800	16,467	15,000	16,200	17,333	18,400	18,900	17,567	15,367	17,733
As	6.1	5.4	5.4	5.1	16.8	16.5	7.0	11.9	6.9	16.4
B	5.3	4.7	---	---	6.1	5.4	6.3	4.0	---	4.3
Ba	98.4	105.7	81.8	109	213	203	99.9	124	74.6	177
Be	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.3
Cd	---[a]	0.4	---	---	1.17	0.98	0.88	0.9	0.5	0.9
Cr	32	34	30	32	39	41	39.7	36	30	39
Cu	11.7	28	19	18	44.9	40.8	39.4	41.7	24.3	41.7
Fe	25,167	22,400	26,900	27,233	53,067	53,400	37,300	53,300	29,700	52,200
Hg	0.08	0.14	0.09	0.12	0.22	0.13	0.11	0.14	0.09	0.15
Mg	6787	6850	8000	7847	7267	7747	9590	8830	7963	7877
Mn	501	492	541	872	3180	2320	405	410	391	1657
Mo	---	---	---	---	---	---	---	---	---	---
Ni	23	30	31	34	50	46	40	42.7	30	43
Pb	---	110	29	34	73	74	52	58	71	78
Se	0.82	0.94	0.4	0.4	1.5	0.8	---	---	---	0.8
Sr	52.1	63.8	35.3	36.9	60.7	55.4	41.3	39.8	30.2	51.3
V	54.7	52.6	54.2	57.1	68.3	70.5	66.8	65.7	57	70.5
Zn	63.6	229	259	259	691	613	532	746	265	582

[a] Analyte was less than 2 times the detection limit.

Table 6. Sediment Analysis for Trace Elements: Impoundment sites. Values are expressed as ppm (Dry Weight).

ANALYTE	SITE							
	U1	U2	H1	H2	E1	E2	W1	W2
Al	19,600	27,200	16,100	17,167	17,467	19,767	27,633	28,400
As	13	13	15.7	13.9	23	16.9	15.3	17
B	5.8	5.4	6.8	6.9	6.6	6.5	6.3	7.5
Ba	145	217	163	170	181	208	231	245
Be	0.4	0.48	0.31	0.32	0.31	0.34	0.48	0.46
Cd	1.1	0.97	0.95	1.1	1.3	1.6	0.84	1.67
Cr	46	55	34	39	38	44	54	61
Cu	49.2	63.1	42.8	40.4	52.3	63.9	64.5	80.5
Fe	40,367	43,033	43,200	44,100	56,433	57,933	47,233	57,633
Hg	0.20	0.25	0.24	0.24	0.21	0.28	0.18	0.29
Mg	8046	11,600	6783	7040	7953	9070	12,900	12,500
Mn	756	1270	1127	1240	1100	741	798	954
Mo	--[a]	---	---	---	---	2	---	---
Ni	40	62	41	42	40	45	50	57
Pb	81	140	82	99	147	200	210	300
Se	1.4	0.9	1.3	1.2	1.0	1.5	0.5	0.7
Sr	60.4	57.6	66.5	62.1	59.5	48.7	53.6	55.1
V	72.3	86.6	61.3	64.6	70.7	74.9	84.5	91.9
Zn	450	670	798	642	654	733	459	796

[a] Analyte was less than 2 times the detection limit.

elements detected at the control site. Continuing downstream, the next four sites (NF, IVb, III and II) retained elevated concentrations of cadmium, copper, lead and zinc. Iron concentrations at Sites IVb and II, and arsenic and manganese concentrations at Site II increased again to concentrations at least 100% over control site values.

Impoundments

Sediment samples were collected from impoundments at points close to the creek's entry and exit points. Sediments from the impoundments contained higher concentrations of all inorganic analytes than sediments from the in-stream sites. Molybdenum was the only element not found at every site.

Concentrations of most elements were fairly consistent among impoundments. However, lead concentrations were substantially higher in Westchester lagoon with peak concentrations of 300 ppm.

Within impoundments, a trend demonstrating increasing concentrations between sites occurs with some elements. For example, barium increases from 145 ppm at site U1 to 217 ppm at site U2; from 163 ppm at H1 to 170 ppm at H2; from 181 ppm at E1 to 208 ppm at E2 and from 231 ppm at W1 to 245 ppm at W2. Copper, nickel and lead also follow this trend.

Organochlorines

Although, the U.S. Fish and Wildlife Service sets PCB detection limits at 0.50 ppm, it is possible for laboratories to detect concentrations of 0.1 to 0.2 ppm (John Moore, pers. comm.). The laboratory reported values lower than 0.50 ppm, and actually confirmed many of the values using gas chromatography/mass spectrometry. Therefore, concentration ranges of less than 0.5 ppm PCB are summarized below. However, these concentration ranges are quite low and should only be considered qualitative data.

Sediments from both in-stream sites and impoundments were devoid of any organochlorine compounds except PCBs. Total PCB concentrations ranged from 0.02 ppm to 0.08 ppm in the in-stream sites and 0.02 ppm to 0.10 ppm in the impoundments.

Polycyclic Aromatic Hydrocarbons

Table 7 presents the data for PAHs detected in sediment samples from the in-stream sites and Table 8 presents the data from the impoundments.

Instream sites

Polycyclic aromatic hydrocarbons were not detected in the sediment samples from the control site (XI). However, the total PAH concentrations downstream ranged from 0.24 ppm (Site V) to 3.65 ppm (Site VII). No trends were apparent. Sites VII and III had the highest PAH concentrations with values of 3.65 ppm and 3.3 ppm, respectively. Of the 24 analytes measured, eight were not detected in any of the samples. Fluoranthene, pyrene and phenanthrene were the compounds present in the highest concentrations among the sites.

Impoundments

In general, PAH concentrations in impoundment sediment were substantially lower than in samples from the instream sites. Concentrations of total PAHs ranged from 0.40 ppm (Site H1) to 1.85 ppm (Site U1). The compounds present in the highest concentrations among the sites included pyrene, fluoranthene and chrysene.

Fish

Morphometric data collected from rainbow trout and dolly varden are presented in Table 9.

Inorganics

Data presented in Table 10 displays the concentrations of metals and other elements detected in fish from University lake and Eastchester lagoon. Beryllium, molybdenum, lead and vanadium were not detected in any fish samples. Arsenic was found in all fish from University lake, but in only one fish from Eastchester lagoon. Cadmium was found in low concentrations (0.05 and 0.06 ppm) in two fish from University lake. Mercury concentrations ranged from 0.08 to 0.51 ppm and was detected in all fish. However, fish from University lake had

Table 7. Sediment Analysis for Polycyclic Aromatic Hydrocarbons: Instream sites. Values are expressed as ppm (Wet Weight).

ANALYTE[a]	SITE									
	XI	X	VII	VI	V	IVa	NF	IVb	III	II
Np	---[b]	---	---	---	---	---	---	---	---	---
2MeNp	---	---	---	---	---	---	---	---	---	---
1MeNp	---	---	---	---	---	---	---	---	---	---
BiPh	---	---	---	---	---	---	---	---	---	---
DiMeNp	---	---	---	---	---	---	---	---	---	---
Acenpy	---	---	---	---	---	---	---	---	---	---
Acenp	---	---	0.05	---	---	---	---	---	---	---
TMeNp	---	---	---	---	---	---	---	---	0.04	---
Fluo	---	---	0.06	---	---	---	0.02	---	---	---
Phen	---	0.06	0.51	0.05	0.04	0.51	0.22	0.16	0.53	0.20
Anth	---	---	0.10	---	---	---	0.03	---	0.16	0.09
1MePh	---	---	0.03	---	---	---	0.05	0.03	0.04	0.03
FlAn	---	0.08	0.62	0.05	0.05	0.04	0.27	0.18	0.60	0.22
Pyr	---	0.09	0.52	0.06	0.06	0.08	0.27	0.15	0.46	0.21
BaA	---	0.03	0.25	0.02	---	0.03	0.10	0.07	0.31	0.12
Chry	---	0.05	0.26	0.04	0.05	0.08	0.17	0.15	0.31	0.18
BbFl	---	0.05	0.31	0.03	0.03	0.02	0.09	0.05	0.17	0.06
BkFl	---	---	0.26	---	---	0.02	0.03	0.04	0.16	0.04
BeP	---	0.04	0.16	0.03	0.03	0.02	0.05	0.03	0.11	0.05
BaP	---	0.03	0.19	---	---	---	0.05	0.03	0.14	0.04
Pery	---	0.02	0.08	0.02	---	0.03	0.03	0.04	0.09	0.05
InPy	---	0.02	0.12	---	---	---	---	0.03	0.07	0.04
DiBen	---	---	0.03	---	---	---	---	---	---	---
BghiPe	---	0.03	0.10	---	---	0.22	---	0.04	0.06	0.05
Total	---	0.48	3.65	0.29	0.24	0.39	1.39	0.97	3.30	1.37

[a] Abbreviations for PAHs are explained in Table 4.
[b] Analyte was less than 2 times the detection limit.

Table 8. Sediment Analysis for Polycyclic Aromatic Hydrocarbons: Impoundment sites. Values are expressed as ppm (Wet Weight).

ANALYTE[a]	SITE							
	U1	U2	H1	H2	E1	E2	W1	W2
Np	---[b]	---	---	---	---	---	---	---
2MeNp	---	---	---	---	---	0.03	---	---
1MeNp	---	---	---	---	---	---	---	---
BiPh	---	---	---	---	---	---	---	---
DiMeNp	---	---	---	---	---	0.03	---	---
Acenpy	---	---	---	---	---	---	---	---
Acenp	---	---	---	---	---	---	---	---
TMeNp	---	---	---	---	0.02	0.03	---	0.02
Fluo	0.02	---	---	---	0.02	0.02	---	---
Phen	0.28	0.06	0.04	0.05	0.19	0.18	0.04	0.16
Anth	0.03	---	---	---	0.04	0.03	---	---
1MePh	0.02	---	---	---	0.05	0.05	---	0.04
FlAn	0.34	0.10	0.06	0.06	0.22	0.26	0.05	0.22
Pyr	0.31	0.12	0.09	0.09	0.22	0.30	0.09	0.24
BaA	0.11	0.04	0.02	0.03	0.07	0.10	0.02	0.07
Chry	0.21	0.09	0.06	0.07	0.14	0.18	0.21	0.16
BbFl	0.17	0.05	0.05	0.03	0.09	0.13	0.04	0.09
BkFl	0.09	---	---	---	0.03	0.04	---	0.03
BeP	0.18	0.04	0.04	0.02	0.07	0.09	0.03	0.08
BaP	0.09	0.03	0.02	---	0.04	0.06	---	0.06
Pery	0.31	0.03	---	---	0.03	0.04	---	0.05
InPy	0.03	0.03	---	---	0.03	0.05	---	0.02
DiBen	---	---	---	---	---	---	---	---
BghiPe	0.02	0.03	0.02	---	0.04	0.05	0.03	0.03
Total	1.85	0.61	0.40	0.36	1.30	1.66	0.50	1.26

[a] Abbreviations for PAHs are explained in Table 4.
[b] Analyte was less than 2 times the detection limit.

Table 9. Morphometric Data for Fish Collected from Chester Creek.

Location	Date Collected	Sample #	Species	Total Length (cm)	Weight (g)
UL[a]	23 Aug 91	UD1	D. Varden	28.6	215.1
UL	23 Aug 91	UD2	D. Varden	24.1	137.8
UL	23 Aug 91	UR1	R. Trout	28.2	224.7
UL	23 Aug 91	UR2	R. Trout	24.1	140.8
UL	23 Aug 91	UR3	R. Trout	23.9	151.7
UL	23 Aug 91	UR4	R. Trout	28.9	247.0
UL	23 Aug 91	UR5	R. Trout	26.7	220.8
UL	23 Aug 91	UR6	R. Trout	30.2	259.5
EL[b]	11 Sep 91	ER1	R. Trout	42.0	850.0
EL	11 Sep 91	ER2	R. Trout	35.0	459.8
EL	11 Sep 91	ER3	R. Trout	38.5	750.0
EL	11 Sep 91	ER4	R. Trout	35.2	514.0
EL	11 Sep 91	ER5	R. Trout	36.0	610.1
EL	11 Sep 91	ER6	R. Trout	28.0	223.3

[a] University Lake
[b] Eastchester Lagoon

Table 10. Fish Analysis for Trace Elements: Values are expressed as ppm (Dry Weight).

ANALYTE	Sample #						
	UD2	UR1	UR2	UR3	ER4	ER5	ER6
Al	64	23	19	24	28	15	13
As	0.38	0.20	0.71	0.20	---	---	0.76
B	---[a]	---	---	---	---	---	10
Ba	2.8	1.5	0.42	0.57	0.72	0.50	0.30
Be	---	---	---	---	---	---	---
Cd	0.06	0.05	---	---	---	---	---
Cr	0.99	0.94	0.44	0.97	0.36	0.88	0.49
Cu	7.7	5.0	7.0	2.7	3.6	4.9	4.8
Fe	210	119	116	137	91	77	63
Hg	0.33	0.51	0.29	0.20	0.08	0.16	0.18
Mg	1090	1190	1160	992	728	824	1050
Mn	16	11	3.7	4.6	5.7	5.4	2.9
Mo	---	---	---	---	---	---	---
Ni	0.61	0.54	---	0.52	---	0.48	---
Pb	---	---	---	---	---	---	---
Se	1.9	1.8	2.0	1.6	1.5	0.9	1.7
Sr	21.5	11	5.1	7.2	5.5	5.1	5.1
V	---	---	---	---	---	---	---
Zn	97	91.1	121	83.3	64.2	91.7	92.9

[a]Analyte was less than 2 times the detection limit.

higher overall values than those from Eastchester lagoon. Nickel was only detected in a single fish from Eastchester lagoon.

Organochlorines and PCBs

Low concentrations of DDT, mostly in the form of 4,4 DDE, were found in all fish analyzed. In rainbow trout, values ranged from 0.01 to 0.04 ppm and were consistent between ponds. The single dolly varden collected from University lake had 0.79 ppm DDE which was the highest concentration measured.

Polycyclic Aromatic Hydrocarbons

The three fish from Eastchester lagoon contained low concentrations of mostly naphthalene-based PAHs. Naphthalene was found in two of the three rainbows from Eastchester lagoon at concentrations of 0.3 and 0.2 ppm. Other PAHs detected in these fish were 2-methylnaphthalene (0.3 to 0.5 ppm) and 1-methylnaphthalene (0.2 to 0.4 ppm). One fish contained residues of 2,6-dimethylnaphthalene, 2,3,4-trimethylnaphthalene and phenanthrene in concentrations of 0.3, 0.2, and 0.4 ppm, respectively. The only PAH detected in fish from University lake was 0.02 ppm 2-methylnaphthalene, which was measured in the single dolly varden submitted for analysis.

Avian Eggs

Egg data are reported in Table 11. No anomalous findings occurred, and all egg parameters were within normal value ranges for each species.

Inorganics

Aluminum, arsenic, boron, beryllium, cadmium, chromium, nickel molybdenum, lead and vanadium were not found in any of the eggs, and table 12 displays the concentrations of the remaining elements. Mercury was detected in all of the eggs with concentrations ranging from 0.02 ppm in both Canada goose eggs to 0.64 ppm in a mallard egg. Selenium concentrations among species and locations

Table 11. Parameters for Eggs Collected at Impoundments Along Chester Creek.

Location	Date Collected	Sample #	Species	Egg Weight(g)	Eggshell Thickness (mm)	Ratcliffe Index
UL[a]	21 May 91	UC1	Goose[d]	111.6	0.530	3.16
UL	21 May 91	UC2	Goose	109.8	0.543	3.21
UL	21 May 91	UC3	Goose	114.2	0.500	3.13
UL	21 May 91	UC4	Goose	110.9	0.550	3.41
UL	21 May 91	UC5	Goose	104.7	0.508	3.22
UL	21 May 91	UC6	Goose	114.4	0.525	3.28
				$\bar{x}$=110.9	$\bar{x}$=0.526	$\bar{x}$=3.24
UL	17 Jun 91	UG1	Grebe[e]	35.6	0.359	2.01
UL	17 Jun 91	UG2	Grebe	38.2	0.300	1.75
				$\bar{x}$= 36.9	$\bar{x}$=0.330	$\bar{x}$=1.88
EL[b]	22 May 91	EM1	Mallard	45.4	0.243	1.62
EL	22 May 91	EM2	Mallard	48.4	0.287	1.88
EL	22 May 91	EM3	Mallard	48.0	0.285	1.87
EL	22 May 91	EM4	Mallard	48.2	0.281	1.93
EL	22 May 91	EM5	Mallard	48.4	0.284	1.92
EL	22 May 91	EM7	Mallard	51.5	0.292	1.90
				$\bar{x}$= 48.3	$\bar{x}$=0.279	$\bar{x}$=1.85
WL[c]	25 May 91	WW1	Mew Gull	44.6	0.248	1.40
WL	25 May 91	WW2	Mew Gull	44.7	0.229	1.93
WL	25 May 91	WW3	Mew Gull	42.5	0.235	1.25
WL	25 May 91	WW4	Mew Gull	47.1	0.257	1.36
				$\bar{x}$= 44.7	$\bar{x}$=0.242	$\bar{x}$=1.49
WL	21 Jun 91	WG1	Grebe	40.3	0.351	1.93
WL	21 Jun 91	WG2	Grebe	45.0	0.329	1.87
WL	21 Jun 91	WG3	Grebe	37.1	0.327	1.82
WL	21 Jun 91	WG4	Grebe	36.1	0.315	1.83
WL	21 Jun 91	WG5	Grebe	28.4	0.346	1.96
WL	21 Jun 91	WG6	Grebe	32.2	0.318	1.69
				$\bar{x}$= 36.5	$\bar{x}$=0.331	$\bar{x}$=1.85

[a] University Lake
[b] Eastchester Lagoon
[c] Westchester Lagoon
[d] Canada goose
[e] Red-necked grebe

Table 12. Egg Analysis for Trace Elements: Values are expressed as ppm (Dry Weight).

ANALYTE	Sample #										
	UC4	UC6	UG2	EM4	EM5	EM7	WG4	WG5	WG6	WW2	WW4
Al	---[a]	---	---	---	---	---	---	---	---	---	---
As	---	---	---	---	---	---	---	---	---	---	---
B	---	---	---	---	---	---	---	---	---	---	---
Ba	2.8	5.4	0.3	4.5	5.5	2.5	0.2	2.4	2.2	0.8	2.3
Be	---	---	---	---	---	---	---	---	---	---	---
Cd	---	---	---	---	---	---	---	---	---	---	---
Cr	---	---	---	---	---	---	---	---	---	---	---
Cu	2.7	2.1	2.3	3.3	1.7	2.8	2.2	2.3	1.1	1.6	1.4
Fe	101	118	110	117	108	105	130	144	118	104	107
Hg	0.02	0.18	0.56	0.47	0.48	0.64	0.38	0.34	0.57	0.35	0.21
Mg	460	426	500	345	304	305	534	477	452	370	522
Mn	2.6	3.5	2.5	2.0	1.9	2.0	1.9	3.6	6.1	2.0	2.4
Mo	---	---	---	---	---	---	---	---	---	---	---
Ni	---	---	---	---	---	---	---	---	---	---	---
Pb	---	---	---	---	---	---	---	---	---	---	---
Se	1.1	0.8	4.5	2.5	1.6	0.4	2.5	2.5	2.8	2.7	1.5
Sr	2.5	3.2	1.8	3.7	3.7	2.8	1.7	3.7	4.0	5.4	7.5
V	---	---	---	---	---	---	---	---	---	---	---
Zn	45.7	56.6	46.0	58.6	56.7	53.8	44.4	45.9	47.8	47.2	67.9

[a] Analyte was less than 2 times the detection limit.

averaged around 2 ppm. One exception was a grebe egg from University lake which had a concentration of 4.5 ppm selenium. Barium was detected in all eggs and concentrations ranged from 0.20 ppm in a grebe egg to 5.4 ppm in a Canada goose egg.

Organochlorines and PCBs

All eggs had low concentrations of PCBs and DDT (Table 13). Most of the DDT detected was the 4,4 DDE metabolite of DDT. The two mew gull eggs also contained residues of chlordane, and dieldrin was detected in one mew gull egg.

Polycyclic Aromatic Hydrocarbons

No PAHs were detected in the eggs.

DISCUSSION

The results presented in this report are from data collected for a pilot study of the Urban Contaminants Project. This initial study was designed to evaluate the integrity of the project, including methods development and validation and sampling procedures. It was not designed to provide definitive, scientifically rigorous conclusions regarding the contamination of Chester Creek. However, based upon the limited data that was collected, general observations and trends will be discussed.

The majority of the sediment collected from the in-stream sites is contaminated with lead and zinc, when compared to control sediment. Copper, nickel, iron and arsenic were also elevated at most sites from Site V to the mouth of the stream. Elevated concentrations of these elements are also present in the impoundment sediments. The elevated lead and zinc concentrations in Chester Creek predicate the need for additional monitoring. Although, national and state regulatory criteria for contaminated sediments have not been established, several sources set sediment lead criteria below 50 ppm (Beyer, 1990; Crayton and Jackson, 1991). Using this criteria, 7 out of the 10 instream sites, and all of the impoundments sites are above the 50 ppm threshold. Additionally, several sources establish a 200 ppm zinc criteria for fresh-water sediment (Beyer, 1990; Crayton and Jackson 1991; Eisler 1993). Nine out of the ten instream sites, and all of the impoundments sites had zinc concentrations

Table 13. Detectable PCBs and Other OCs in Eggs. Values Expressed as ppm (Wet Weight).

Sample #	Species	Total PCBs*	Total DDTs*	4,4 DDE*	Total Chlordane*
UC1	Goose[a]	---	---	---	---
UC2	Goose	---	---	---	---
UC3	Goose	---	---	---	---
UG1	Grebe[b]	---	0.79	0.79	---
EM1	Mallard	0.45	---	---	---
EM2	Mallard	---	---	---	---
EM3	Mallard	---	---	---	---
WW1	Gull	0.11	0.20	0.20	---
WW3	Gull[c]	2.59	0.96	0.96	0.12
WG1	Grebe	0.35	0.19	0.19	---
WG2	Grebe	0.18	0.17	0.17	---
WG3	Grebe	---	0.75	0.75	---

* Values over 0.10 ppm are presented.

[a] Canada Goose

[b] Red-necked Grebe

[c] Mew Gull

above 200 ppm. The concentrations of zinc and lead do not approach immediate clean-up levels, but these elements should be monitored.

Polycyclic aromatic hydrocarbon analysis revealed minor contamination in the stream. Two sites (Site VII and III) had around 3.0 ppm total PAHs, but the average concentrations of PAHs in Alaskan sediments is 5-113 ppm (Eisler, 1987). It should be noted that the holding time for non-extracted volatiles and semi-volatile organics of 14 days may have been exceeded for all residue samples. Therefore, the PAH and OC/PCB data should be regarded cautiously. Organochlorines and PCBs were only detected in trace amounts, and do not constitute a contamination problem in Chester Creek.

Despite the elevated lead and zinc concentrations in the sediment, the tissue analysis from fish and eggs collected along Chester Creek did not reveal a metals contaminant problem. Lead was not detected in any of the samples, and zinc concentrations were within acceptable ranges (Eisler 1993). Unlike lead, zinc is necessary for normal physiological function. Therefore, it is not surprising to find zinc in the tissues.

Mercury was detected in all tissues. Eisler (1987) recommends criteria for mallard eggs be less than 0.9 ppm, and for various other species, 1.3-2.0 ppm. Although, none of the eggs exceeded these concentrations, two grebe eggs were around 0.55 ppm and a mallard egg was 0.64 ppm, which indicate exposure of the hen to mercury.

Total PAHs were <0.10 ppm in all tissues, and did not present an immediate contaminant problem. However, PAHs are excreted primarily through the bile, and by using whole fish analysis, the PAH concentrations detected in fish tissues may be diluted. Additionally, as mentioned previously, holding times for chemical analyses of volatile and semi-volatile organic compounds were exceeded.

Grebe and gull eggs had the highest concentration of PCB and DDT contamination. Sediment concentrations indicate that OCs and PCBs are not pervasive in the stream, therefore females may be picking up this contamination from someplace other than Chester Creek. Possibly, grebes acquired some of their PCB/DDT load from resident fish in the impoundments. However, analysis of fish from the ponds on which the higher PCB/DDT contaminated eggs were collected show only traces of these compounds. However, chlorinated hydrocarbons are known to bioconcentrate, and this phenomenon cannot be ruled out. Gulls, which are

omnivorous, are known to forage in a wide variety of habitats, including garbage dumps, where contamination by PCBs could have easily occurred.

CONCLUSIONS/RECOMMENDATIONS

The Urban Contaminants project should be reevaluated before monitoring on the remaining streams begins. The study objectives should be focused on addressing specific fish and wildlife concerns using a quantitative study design. A more precise proposal should also incorporate a fish and wildlife survey of the area. It is difficult to speculate on adverse contaminant impacts to unknown trust resources. Better field records are needed, complete with sampling site photographs. A defined sampling schedule would expedite efforts to get samples to the analytical laboratories prior to holding time expiration.

Future monitoring studies should be scientifically rigorous and incorporate quality assurance/quality control (QA/QC) considerations. If these data are to be compared among sites within years and data is to be collected on a five year cycle, statistically valid study designs are necessary. Statistical tests and analytical approaches should be addressed in the proposal.

Collection of water quality data should be considered in the project, especially if bioassay testing continues. Limnological parameters such as pH and hardness affect both biological organisms and bioavailability of contaminants from sediment.

Regarding Chester Creek specifically, several recommendations can be made: 1) The control site should be moved further upstream. Although, PAHs, OCs and PCBs were not detected in the control site sediments, concentrations of several trace elements (nickel, arsenic, chromium and zinc) may be higher than acceptable background values: 2) Replicate sites would provide a better range of normal values: 3) The wetlands area adjacent to the Merrill Field Landfill should be aggressively monitored. Wildlife may use this area more frequently than the confluence of the North Fork drainage ditch and the main stem of Chester Creek. Upon visual inspection of this wetland, an oily sheen on the surface waters was observed, complete with noxious aroma.

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